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GASEOUS EFFLUENT RELEASE POINTS IN THE K-29 AREA

AUTHORS:

G. W. Addington
L. D. Blakeney
L. H. Gooch

UNION CARBIDE CORPORATION
NUCLEAR DIVISION
OAK RIDGE GASEOUS DIFFUSION PLANT

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UNION CARBIDE

OAK RIDGE GASEOUS DIFFUSION PLANT
P. O. Box P
Oak Ridge, Tennessee 37830

#787

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G. W. Addington
L. D. Blakeney
L. H. Gooch

UNION CARBIDE CORPORATION
NUCLEAR DIVISION

Oak Ridge Gaseous Diffusion Plant
Oak Ridge, Tennessee

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INTRODUCTION

The purpose of this report is to list the gaseous effluent release points in the K-29 Area and to provide for each point the information that is pertinent to pollution control. Each operation involved is described briefly, including sketches, with special emphasis on existing controls or treatments. Included is an explanation of pollution information presently being obtained at some of the release points. A classified section of this report, issued under separate cover, provides additional information on the operations involved as well as the complete description of the K-1231 Facility.

I. RELEASE OF CASCADE GASES

Releases of cascade gases may be grouped into four categories according to the source of emission: (1) cascade purge; (2) seal exhaust; (3) wet air evacuation; (4) accidental releases. Releases from the first three categories comprise the total controlled emission from the cascade. Accidental releases contribute only a small fraction of the total emission.

One or more of the release categories may apply to a particular K-29 Area facility. The cascade purge system operates at K-310-3 and K-311-1. Seal exhaust systems operate at K-502-1, K-502-2, K-633, K-413, K-310-3, and K-311-1. Wet air evacuation systems function at K-502-2 (for both units) and K-633. Wet air in the purge cascade system and product withdrawal system is pumped back into the cascade. The most probable areas for accidental releases are the Feed and Tails Operation at K-1131 and the Product Withdrawal Operation at K-413.

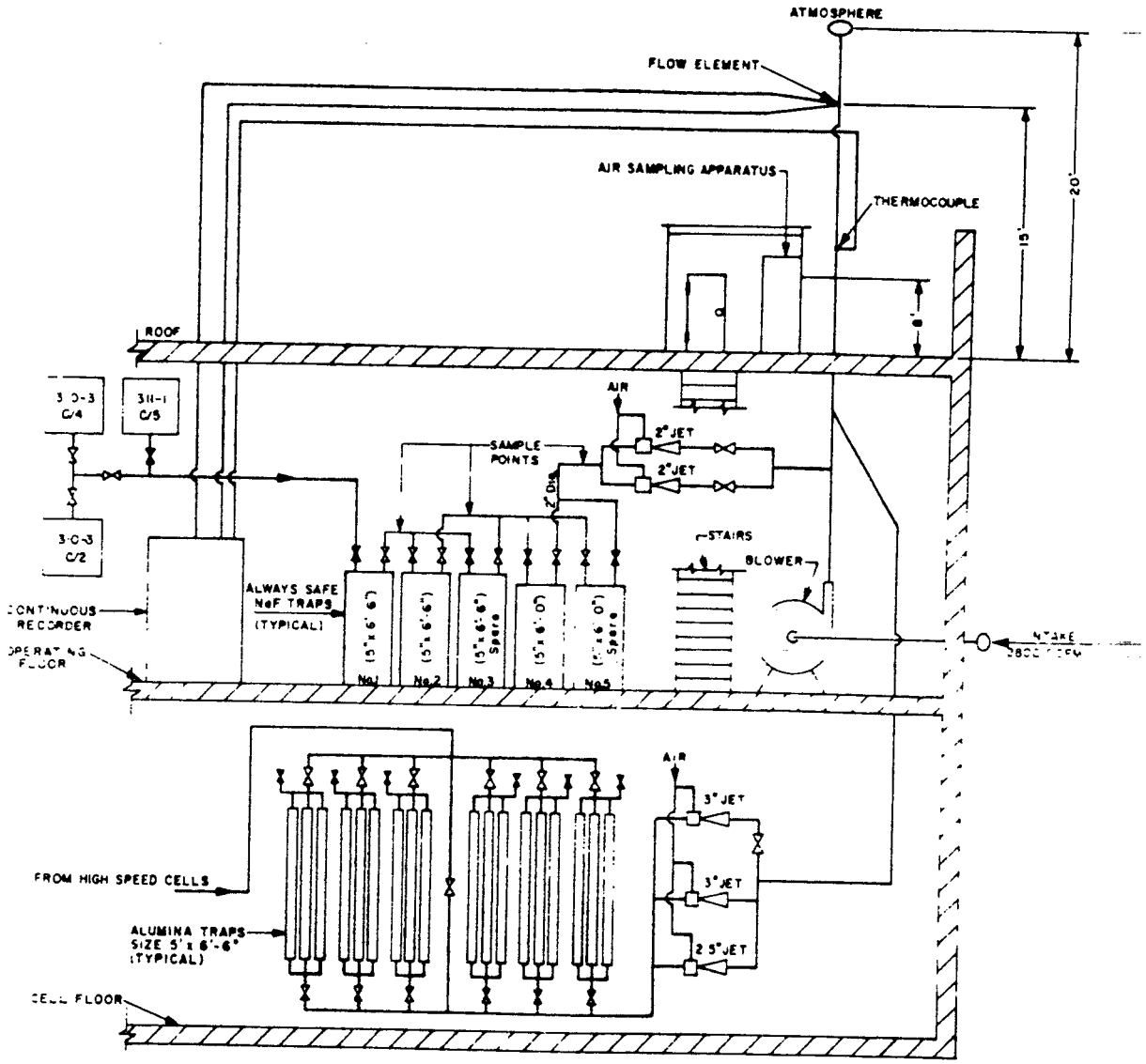
The following pages include an explanation of each general type of release system. More detailed descriptions, including schematic sketches and photographs, are provided for each specific area of application.

A. CASCADE PURGE SYSTEM

Units K-310-3 and K-311-1 operate together as the cascade purge system. Here the light contaminants are separated from the uranium hexafluoride and continuously discharged to atmosphere. The exhaust may contain small amounts of Freon and HF, the latter being generated from the hydrolysis of UF_6. The UF_6 is returned to the cascade system.

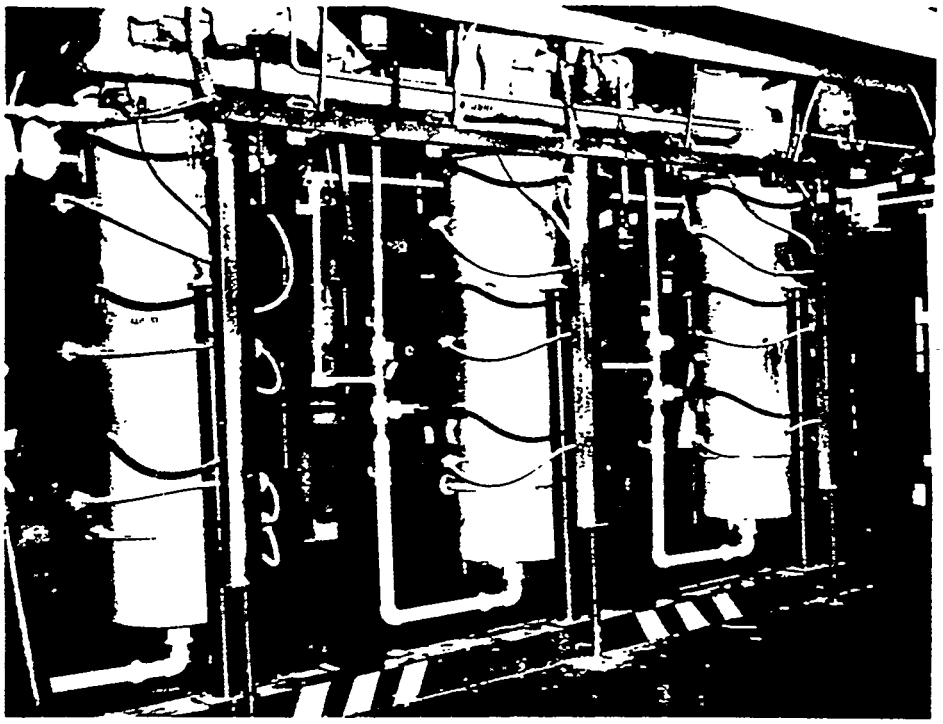
The flow of light contaminants is passed through either sodium fluoride or alumina traps to remove any UF_6 present before discharge to atmosphere. The flows from both trapping systems are combined and diluted with 2800 scfm of atmospheric air before they are exhausted through a single vent stack.

Flow, temperature, uranium concentration, and fluoride concentration are monitored continuously at points on the vent stack above the roof level. The following schematic of the modified purge sampling arrangement shows these sample points as well as the purge flow system described previously. The traps and monitoring equipment are shown in the photographs that follow.



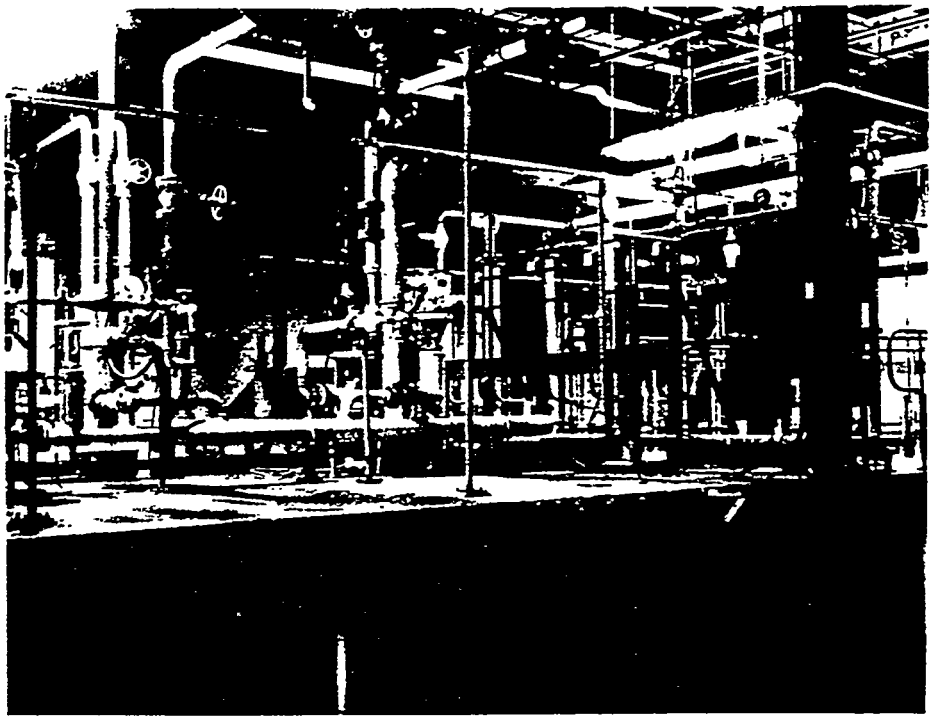
SCHEMATIC OF MODIFIED PURGE SAMPLING ARRANGEMENT

PHOTO NO. PH-71-474



SODIUM FLUORIDE TRAPS, K-311-1

PHOTO NO. PH-71-471



ALUMINA TRAPS, K-311-1

PHOTO NO. PH-71-468

STACK FLOW MONITOR AND BULB SAMPLE MANIFOLD, K-311-1

PHOTO NO. PH-71-1247

CONTINUOUS STACK SAMPLING EQUIPMENT, K-311-1

B. SEAL EXHAUST SYSTEMS

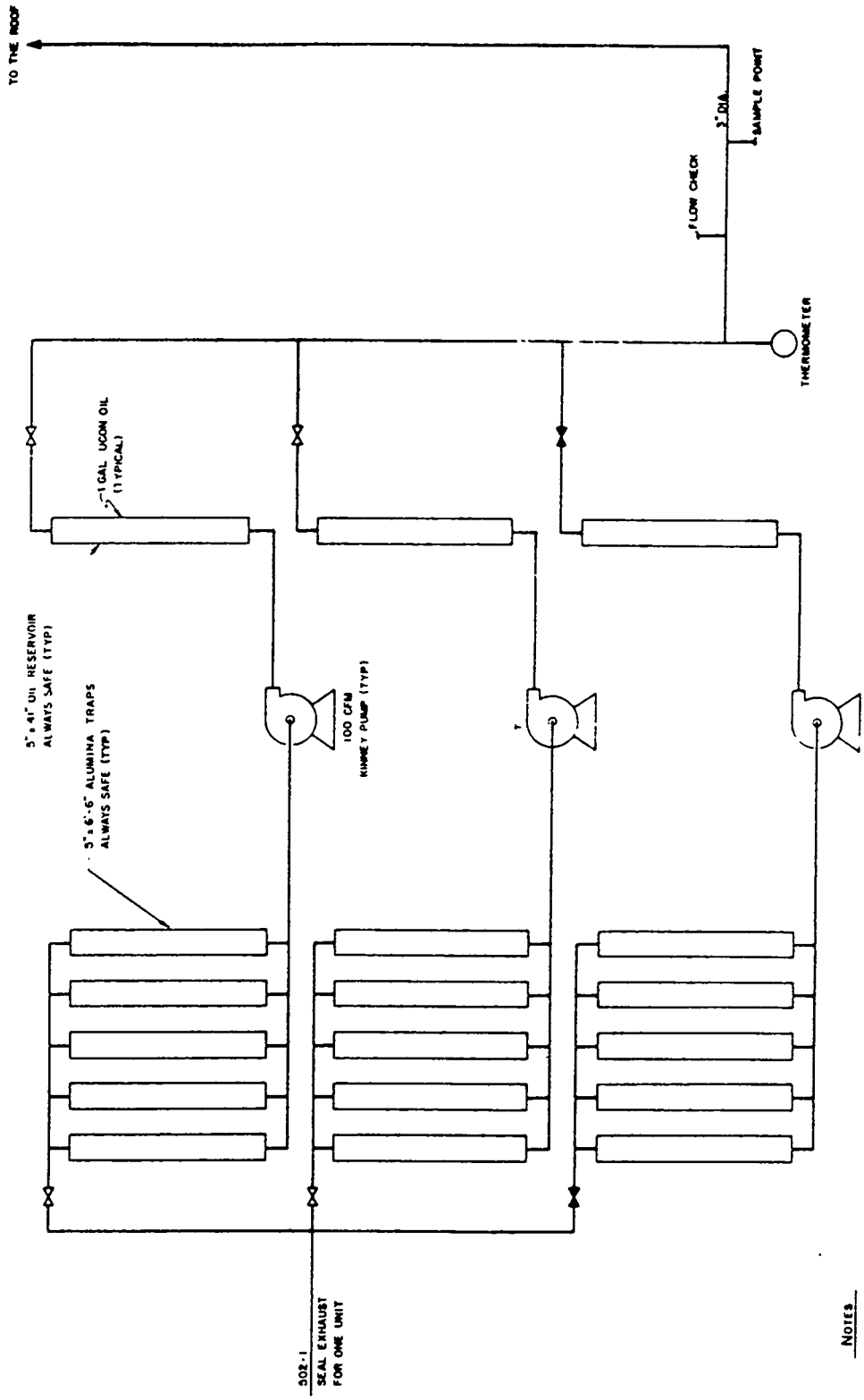
Compressors, equipped with special shaft seals designed to restrict air inleakage around the shaft, are used throughout the ORGDP for pumping UF_6. Each of these special shaft seals are connected to a seal exhaust system which is designed to control pressure and discharge exhaust gases from the seals to atmosphere, as illustrated below.

The failure of a seal always creates the probability of UF_6 being evacuated through the seal into the exhaust system. Therefore, seal exhaust systems basically consist of chemical UF_6 traps, pumps, control instrumentation, connecting piping, and discharge stacks.

1. The K-29 Seal Exhaust System

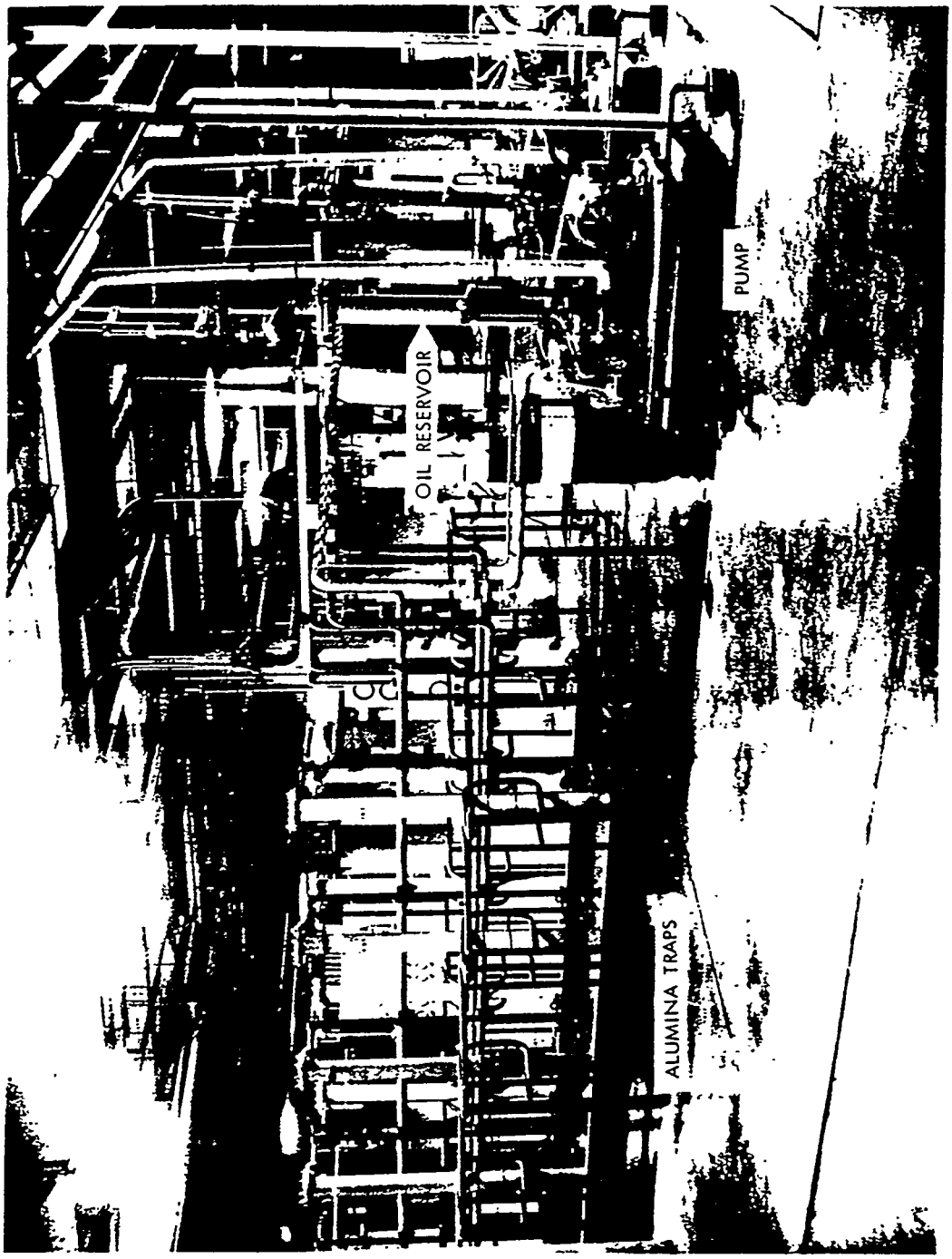
A separate seal exhaust system is provided for each of three cascade units in the K-29 building. The main header connects each seal to the pumping or exhaust station. Each pumping station consists of three 100 CFM Kinney vacuum pumps and fifteen five-inch alumina traps, separated by piping and valves into groups of five. Each pump is connected to the main header through one bank of traps, so that all exhaust gases pass through the alumina traps prior to being discharged to atmosphere.

Sample points have been provided in each discharge stack of the stations in operation for flow measurement and uranium analysis. These sample points, along with typical equipment layout, are shown in the following schematic and photograph.



TYPICAL K-29 SEAL EXHAUST SYSTEM

PHOTO NO. PH-71-470



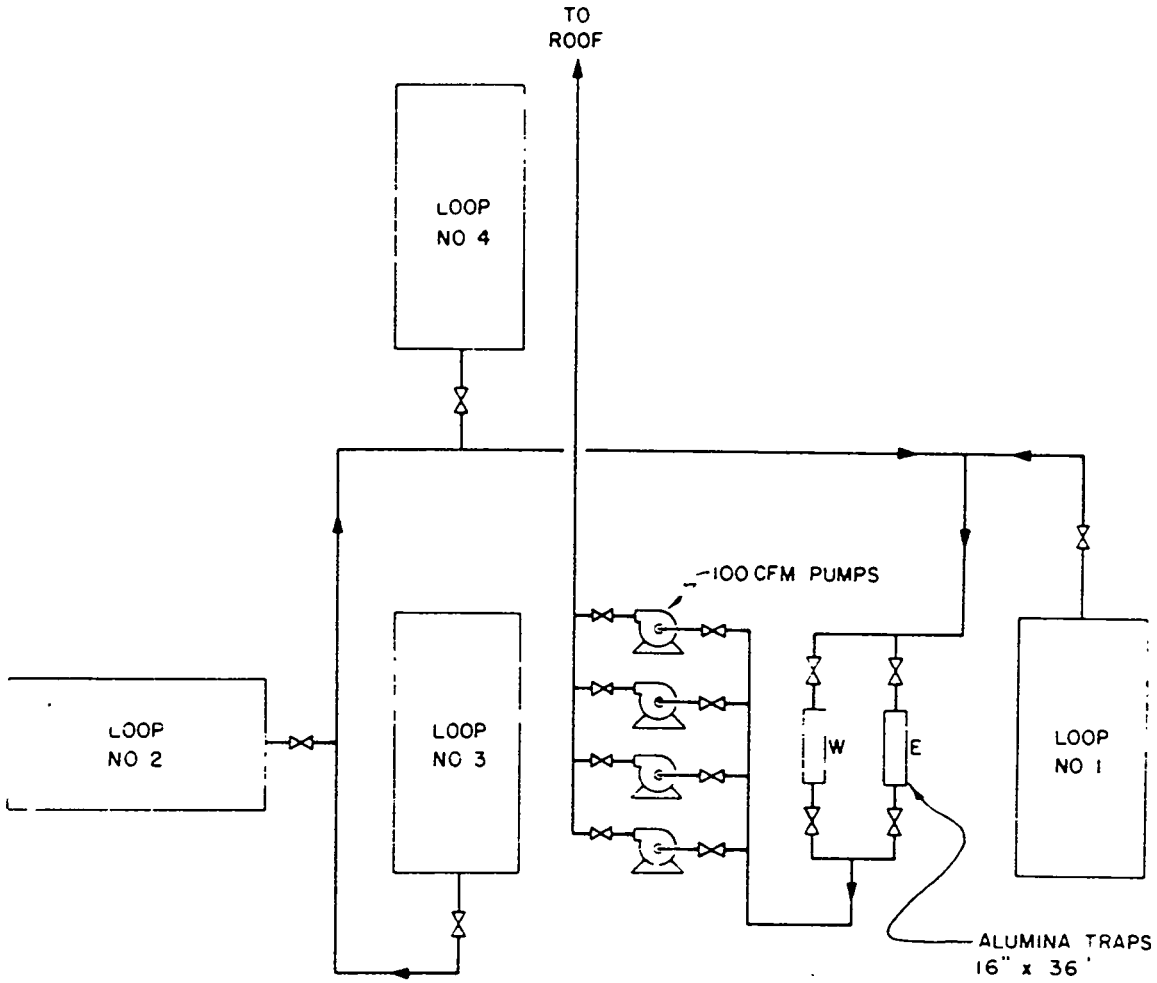
K-29 SEAL EXHAUST STATION

2. The K-633 Seal Exhaust System

The seal exhaust system consists of four vacuum pumps, two alumina traps, and a main header connected to all four loop seal control panels. Normally, one pump and one trap are in service, with the remaining equipment in standby. The exhaust from four seals is the maximum load the system ever experiences, and normally only two are in operation at one time. Therefore, the effluent from this station is very small compared to similar stations throughout the cascade.

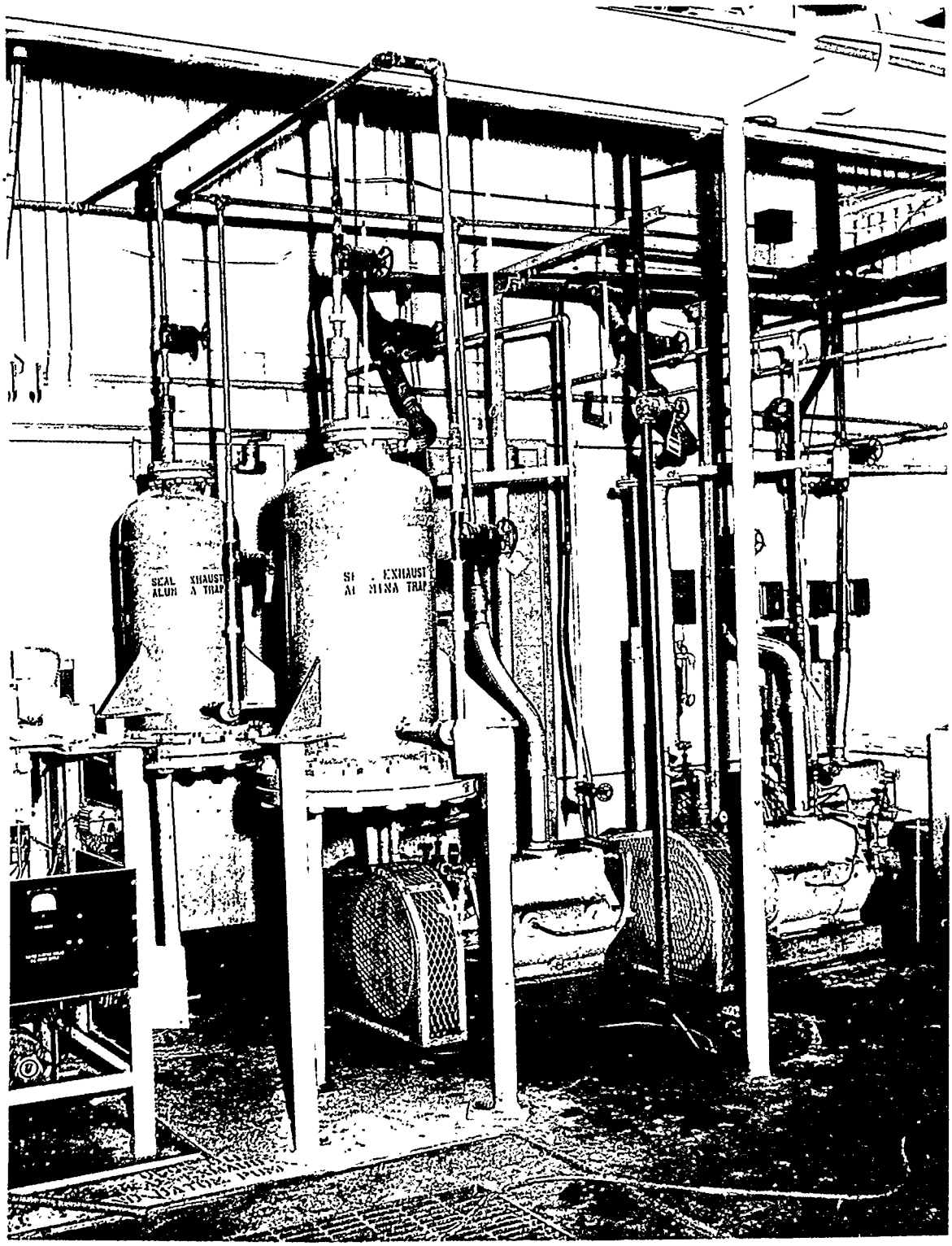
The flow and uranium concentration can be estimated by proportioning values obtained from measurements on the large K-29 seal exhaust system. The ratio would be the number of seals in operation at K-633 compared to the number in operation at K-29.

The following sketch and photograph show the system just described.



K-633 SEAL EXHAUST SYSTEM

PHOTO NO. PH-71-467

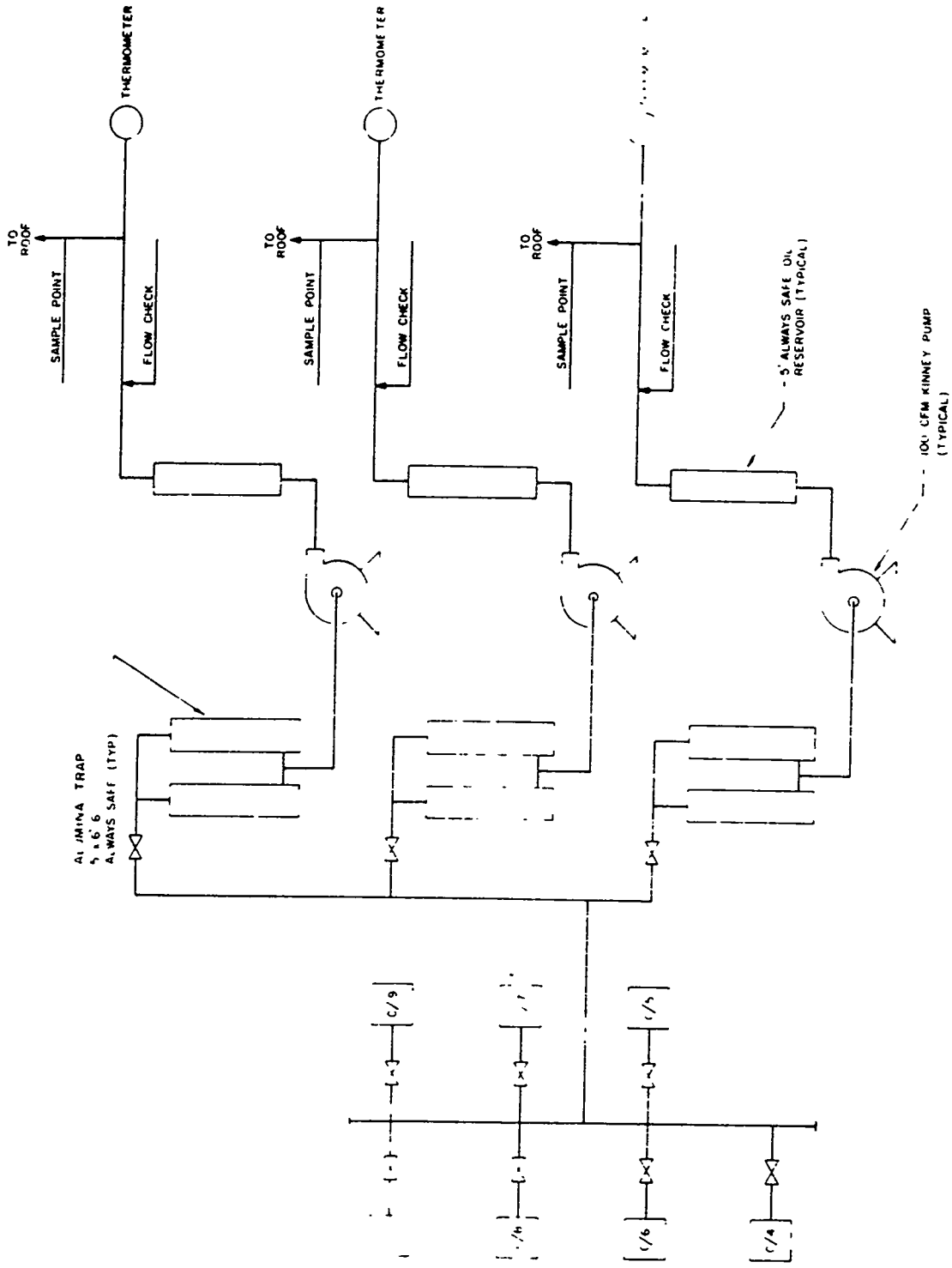


K-633 SEAL EXHAUST SYSTEM

4. The K-310-3 and K-311-1 Seal Exhaust Systems

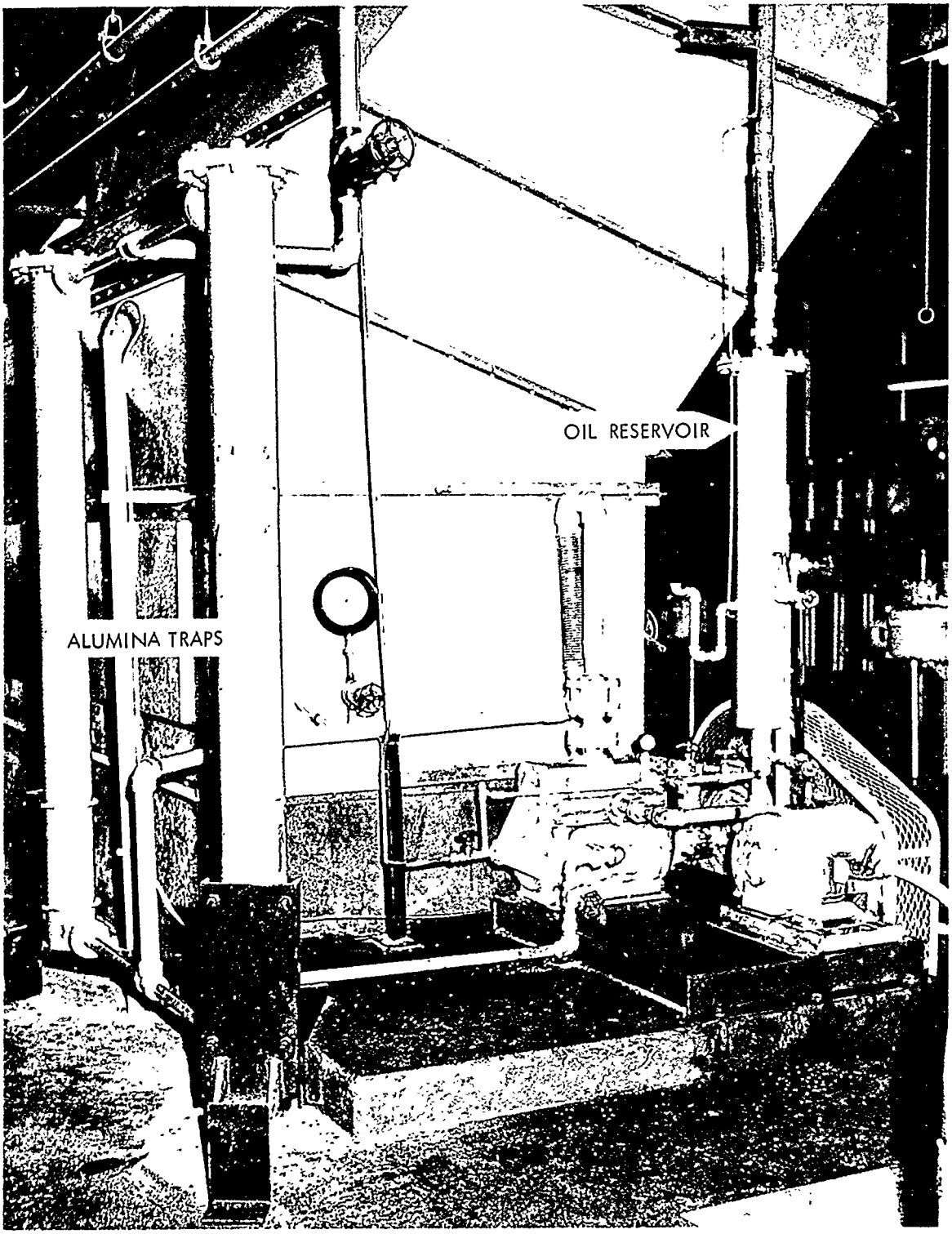
The seal exhaust systems in K-310-3 and K-311-1 consist of three separated pumps, each preceded by two alumina traps. All three pump units are tied into the common header, but each has an individual discharge stack to atmosphere. The following photograph shows the equipment layout for one of the three units, while the single-line diagram shows the entire unit layout and the sample points.

Monthly measurements of flow and uranium concentration are made and from these results the amount of uranium released to atmosphere is calculated.



K-311-1 SEAL EXHAUST SYSTEM
(Same for K-310-3)

PHOTO NO. PH-71-473



K-311-1 SEAL EXHAUST STATION

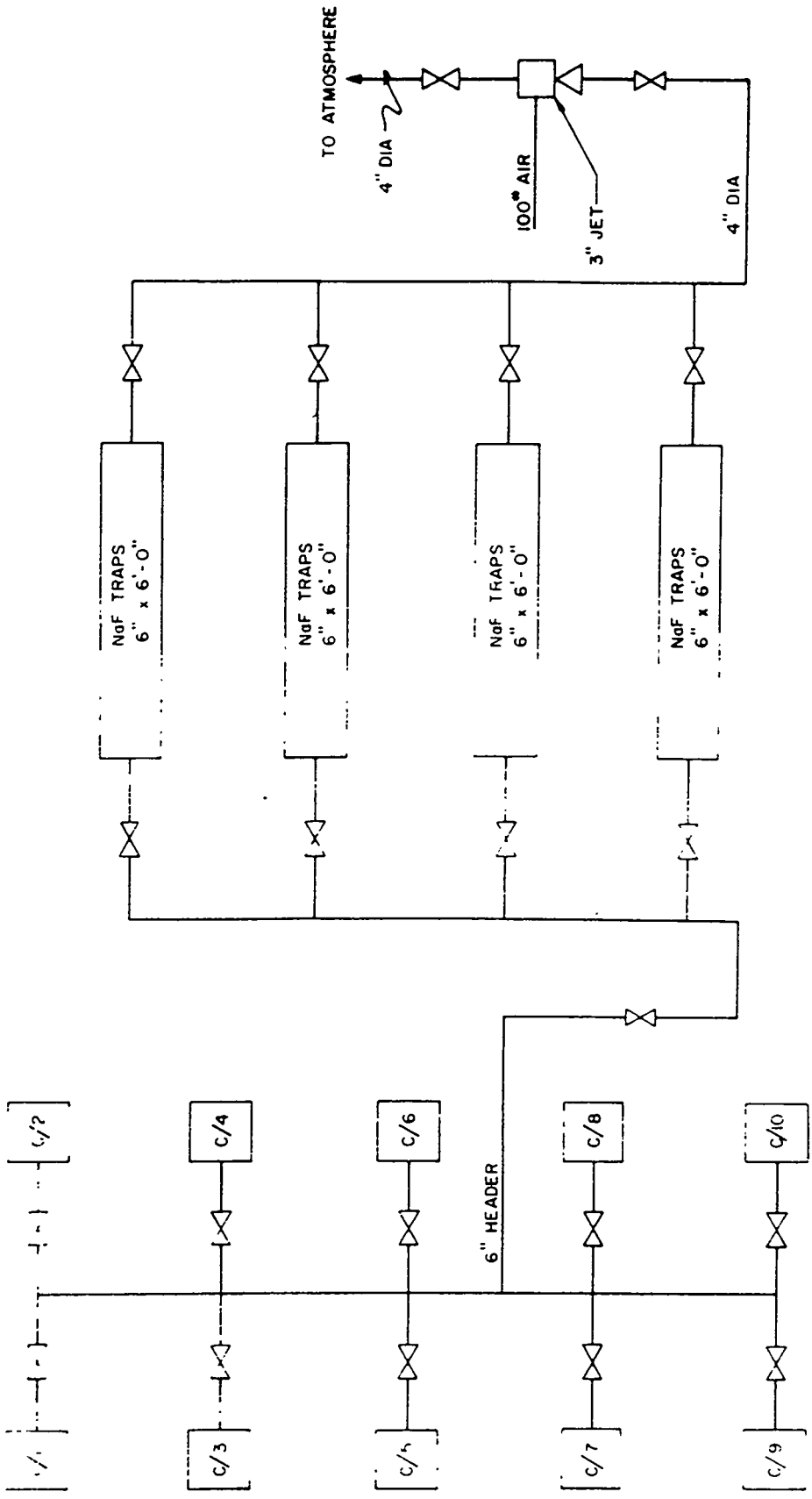
C. WET AIR EVACUATION SYSTEMS

Whenever a cascade system has been purged to a UF_6 negative condition, and the system opened to atmosphere for equipment replacement or other reasons, it is commonly referred to as containing wet air. After the system has been reclosed and soap tested; i.e., all leaks found and repaired, the wet air is then ejected through jets and pumps to atmosphere. One wet air evacuation system located in K-502-2 serves all three units in K-29. A small unit operates at K-633. The UF_6 systems evacuated may range from a few cubic feet in volume to several thousand cubic feet, so wet air evacuation potentially is a significant contributor to the emission of uranium.

The amount of uranium released per given cell evacuation is estimated from approximate cell volumes and maximum UF_6 concentration (<10 ppm). Further investigation is planned to more accurately determine the amount of UF_6 released during an evacuation.

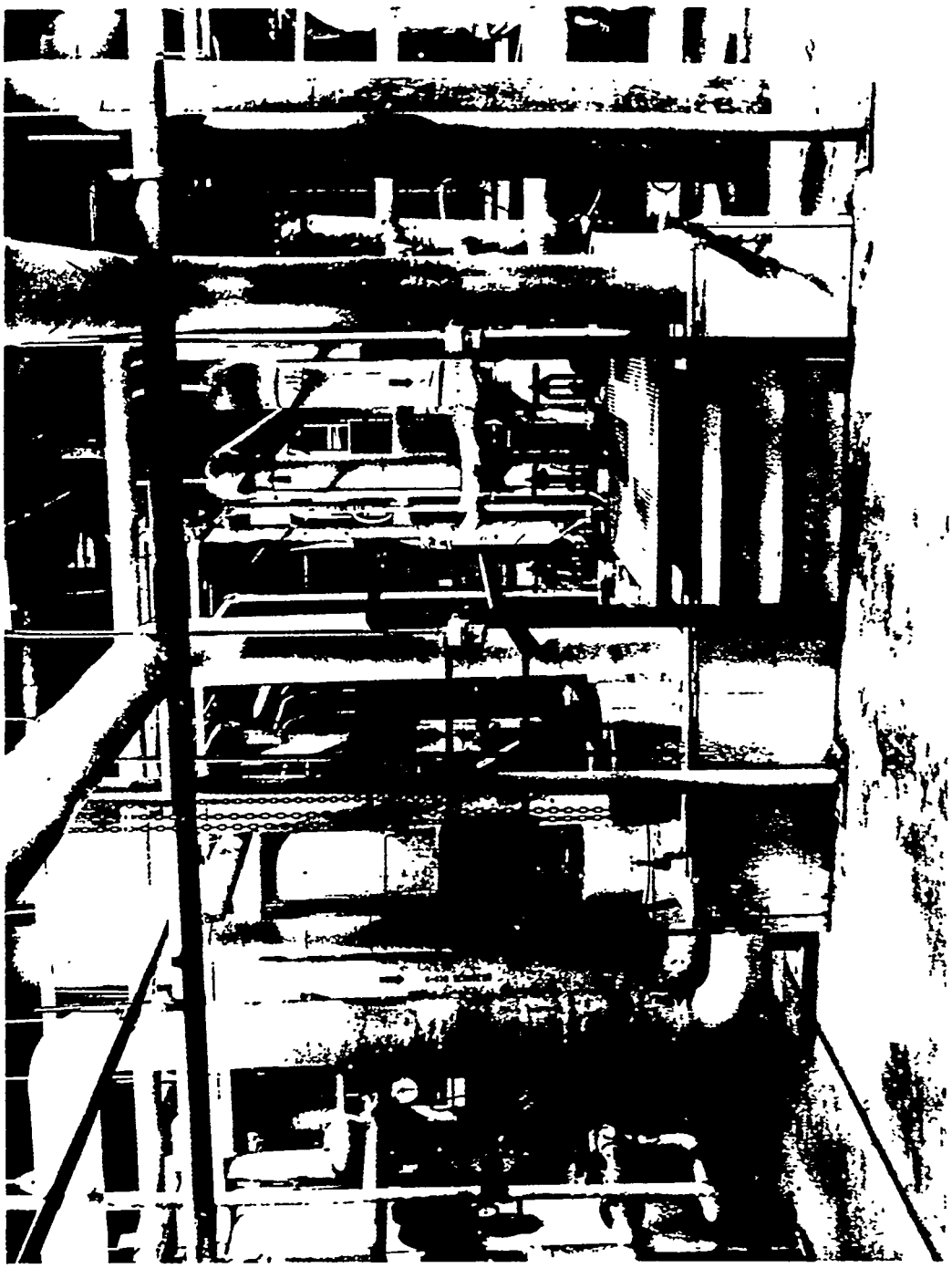
1. K-29 Wet Air Evacuation Station

The K-29 wet air evacuation station is located in K-502-2 and consists of an air operated jet, four chemical traps, and the necessary header and valves to eject from any UF_6 system in K-29. The station is adequately equipped with sodium fluoride traps, which when monitored and regenerated properly, should effectively remove the low amounts of UF_6 ejected from the cascade system. The following schematic and photograph show the system in detail.



K-29 WET AIR EVACUATION SYSTEM

PHOTO NO. PH-71-466



K-29 WET AIR EVACUATION SYSTEM

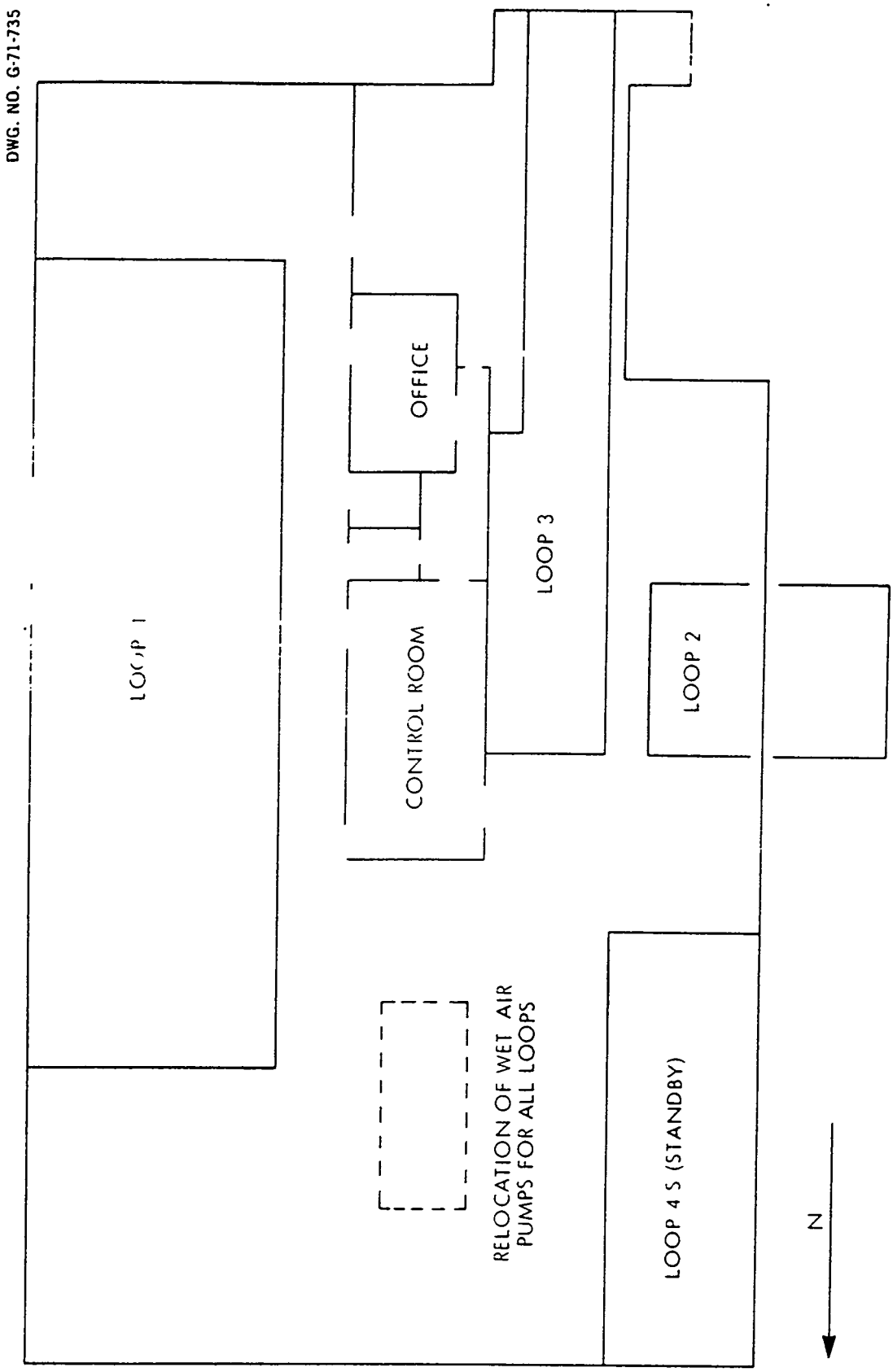
2. K-633 Wet Air Evacuation Stations

Two evacuation stations are in service in K-633, one to eject from Loop No. 1, and one to eject from either Loop No. 2, 3, or 4. Both stations consist of an air jet, pump or pumps, piping, and valves; however, unlike the K-29 station, no chemical traps exist. The frequent use of these stations and the potential pollution emission from such use encourages serious consideration of properly equipping the stations with adequate chemical traps. Both stations are shown in the following schematic and photographs.

3. Proposed Relocation And Modification Of K-633 Wet Air Evacuation System

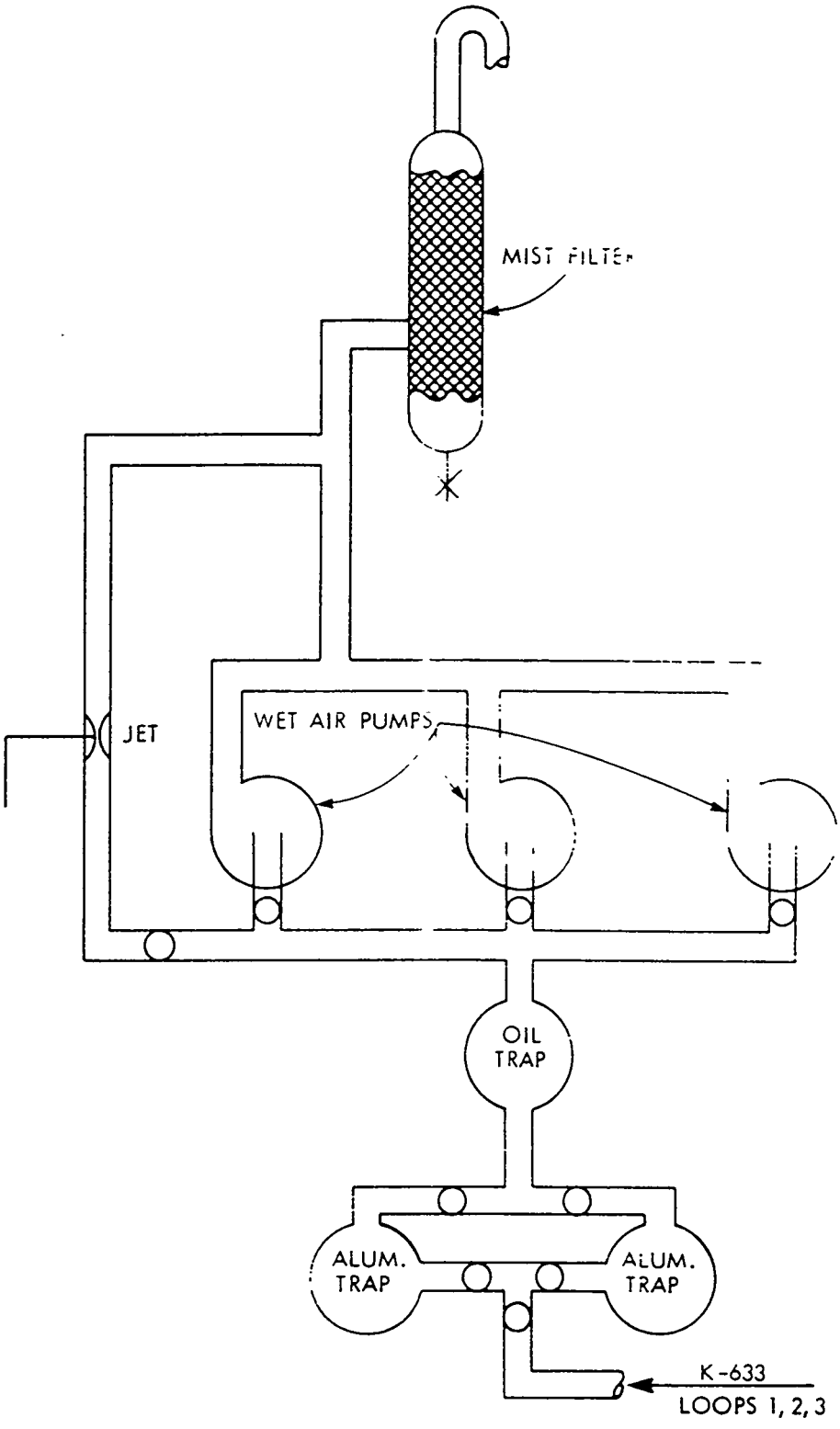
Consolidation and adequately equipping the stations with chemical traps at the present time is somewhat hindered by the lack of space. However, a proposed relocation of two large units of electrical switch gear in the near future will make available adequate space.

The sketches that follow show the probable area of consolidation and a single line diagram of the proposed new station.



K-633 TEST FACILITIES

DWG. NO. G-71-736



POLLUTION CONTROL SCHEME

D. POTENTIAL ACCIDENTAL UF_6 RELEASE POINTS

Normal cascade operating pressures are below atmospheric pressure; therefore, accidental releases are minimal. However, feed, tails, and product withdrawal necessitates handling UF_6 at above atmospheric pressure. This in itself creates a potential accidental release condition associated with equipment failures such as valve bellows, packings, gaskets, etc. Further aggravation is the fact that cylinders containing the high pressure UF_6 must be disconnected from the regular piping system and moved by hoisting mechanisms to temporary storage areas.

Two locations in the K-29 area are included in the accidental release category. They are: K-1131 where the feed and tails operation is in progress at all times, and K-413 where all product withdrawal operations are performed. Both areas are monitored continuously to assist personnel in locating leaks as soon as possible to contain these releases. Any slight leakage during pigtail operations is removed through a vacuum exhaust system which runs continuously. Regardless of precautions and the best of administrative controls, releases of this type will occur, and in most cases only educated guesses can be made as to the amount of UF_6 released.

II. RELEASE OF FLUORINE, HYDROGEN, AND HYDROGEN FLUORIDE

The K-1131 Facility houses three related operations that involve the release of fluorine, hydrogen, and hydrogen fluoride to the atmosphere. The anhydrous HF operation includes the tank farm HF storage and transfer facility. The fluorine plant uses HF supplied by the anhydrous HF operation. The high assay fluid bed also uses HF, but it is presently in standby.

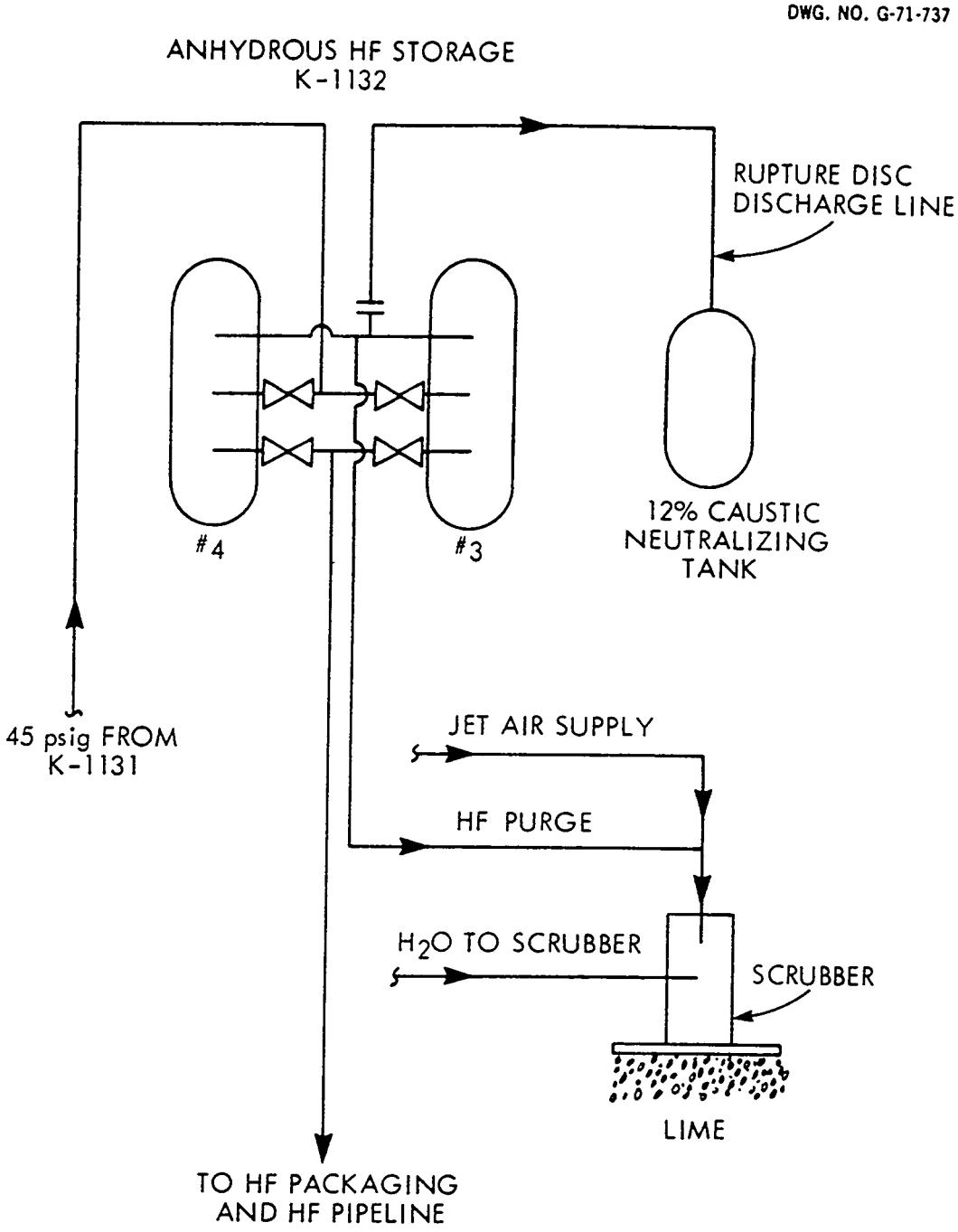
The following pages describe each operation, pointing out points of emission. Frequency, amount, and any existing controls of effluents are mentioned where applicable.

A. ANHYDROUS HF OPERATION, K-1131

The anhydrous HF operation supplies anhydrous HF to various users at the ORGDP. The tank farm, K-1132, consists of two storage tanks for anhydrous HF. The tanks are pressured to 45 psig with air to transfer HF to K-1131 by pipeline. At K-1131 the HF is used for either *packaging* or *pipeline* operations. The packaging operation is the filling of cylinders for transfer to various users. The pipeline operation is simply a direct pipeline to the various units within the area that use anhydrous HF.

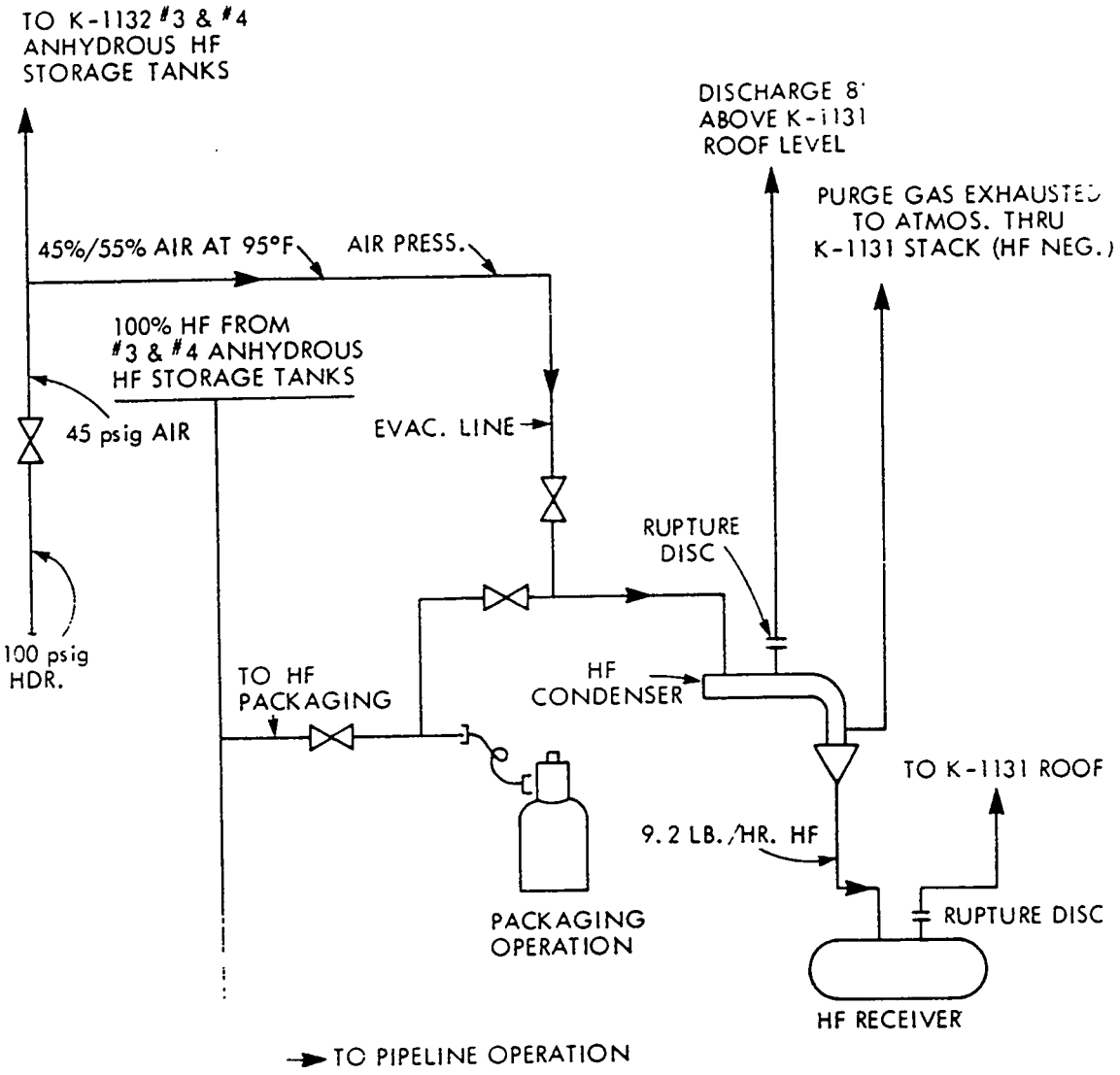
There are two methods by which HF can be released to the atmosphere. Rupture discs are provided throughout the system as a safeguard against high pressure buildup. Releases from these are infrequent and exhaust an undetermined amount of HF to the atmosphere. The second method is normal purging of various parts of the system. At K-1131 a purge and evacuation system recovers the HF by condensation. A very low concentration is exhausted to atmosphere by a discharge vent stack from this unit.

The following sketches show the K-1132 storage facility and a flow diagram for the anhydrous HF operation.



ANHYDROUS HF STORAGE, PACKAGING, AND HF PIPELINE

DWG. NO. G-71-738



K-1131 ANHYDROUS HF OPERATION

B. FLUORINE PLANT OPERATION, K-1131

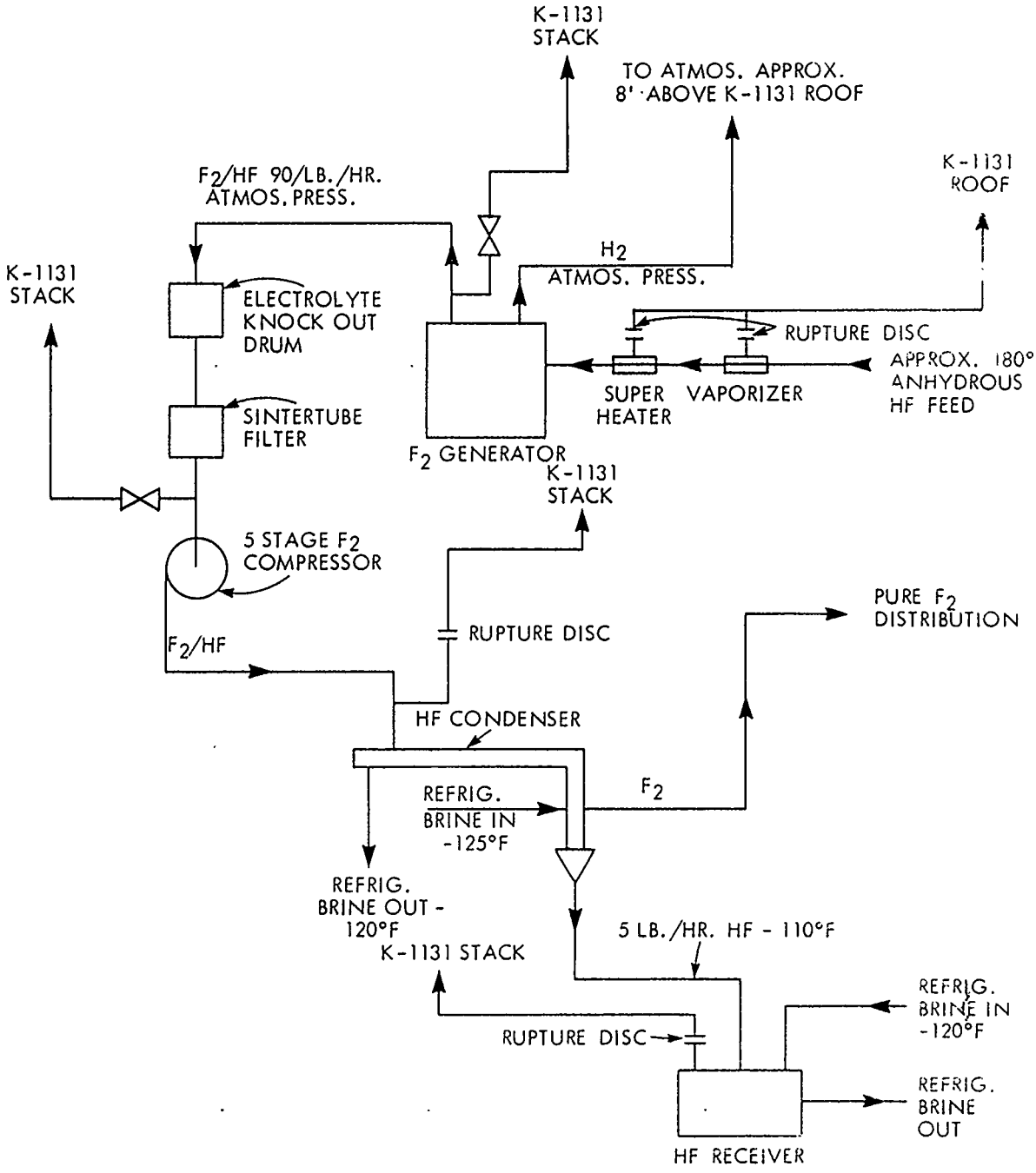
The fluorine is produced from thirteen 5000 and 6000 amp cells using electrolyte containing 40% HF. A controlled feed of anhydrous HF at 4.5 psig and 200°F. is piped to each cell to maintain proper cell electrolyte levels and percentages.

Fluorine and hydrogen gases are produced with the cell pressures controlled at atmospheric pressure. The hydrogen gas is discharged through the necessary piping to atmosphere at a point approximately 10 feet above the K-1131 roof level.

The fluorine gas leaves the cell, passes through an electrolyte *knock out* drum, then through a sintered tube filter to remove any electrolyte carry over. A 5-stage centrifugal compressor discharges the fluorine gas at up to 3.0 psig. The fluorine gas then passes through a HF condenser where the HF is cooled to a liquid and drains to a HF receiver where it is held and transferred back to the K-1131 HF day tanks for reuse. The fluorine, in a gaseous form, is then piped to the K-1131 manifold for distribution. The fluorine headers are arranged so in the event the plant is shut down, emergency or intentional, the F_2 make header and the pump suction header are valved to atmosphere via the K-1131 stacks. Rupture discs are installed on the HF condenser, HF receiver, and HF vaporizer.

The only intentional release of fluorine and HF is during purging of the system. This is not a continuous operation and therefore results in small quantities released to the atmosphere. The following sketch shows the fluorine plant operation in detail.

DWG. NO. G-71-739

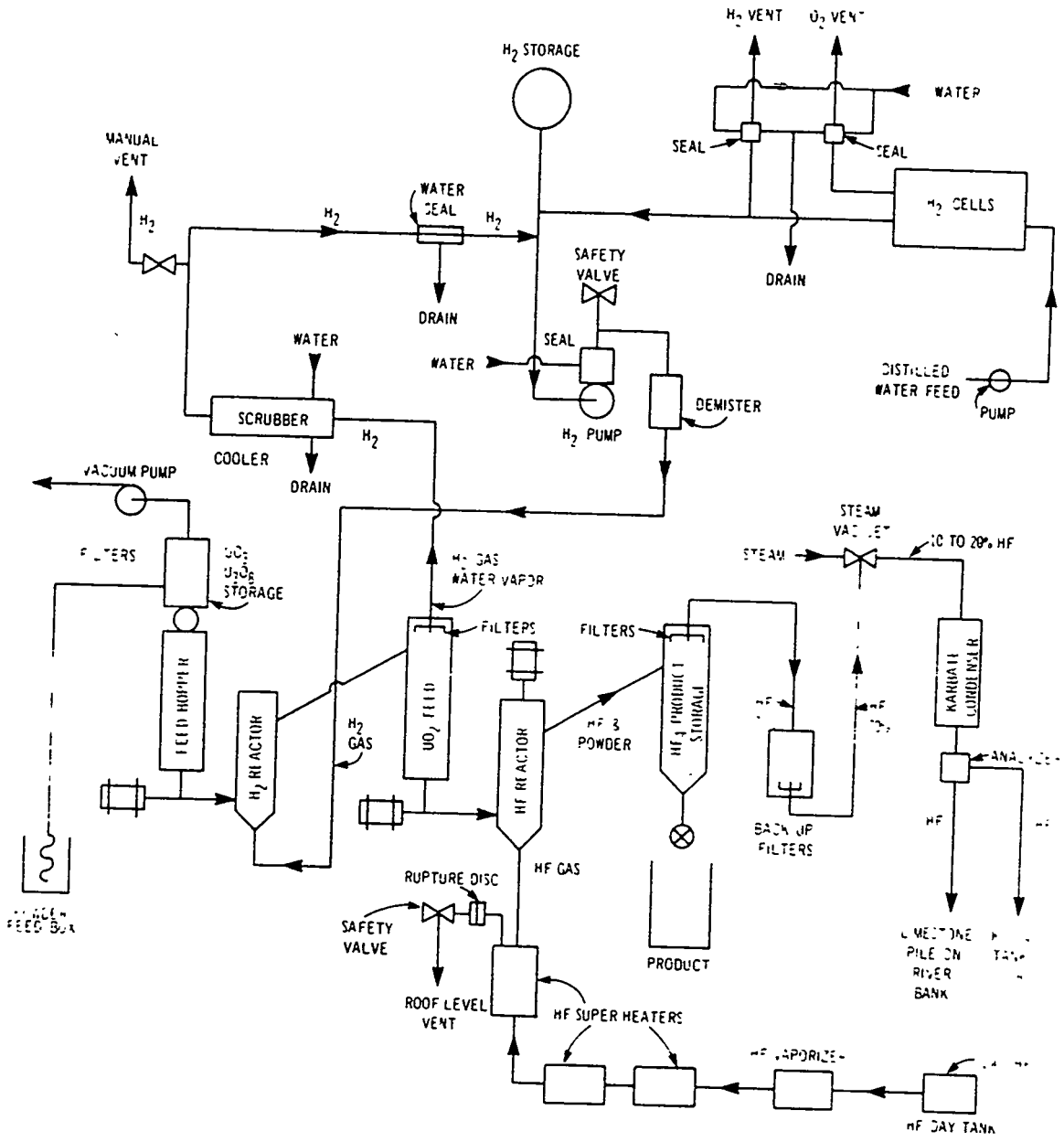


FLUORINE PLANT OPERATION - K-1131

C. HIGH ASSAY FLUID BED, K-1131

The high assay fluid bed at K-1131 is used for converting UO_3 and U_3O_8 to UF_4. The UO_3 and U_3O_8 react with hydrogen gas to form UO_2, which is then reacted with 100% HF gas in a stirred fluid bed reactor to produce the UF_4. The sketch that follows shows the operation in detail. This unit is presently in standby with no emission. However, when this unit is in operation there is considerable venting of hydrogen from the reaction chamber. A filter and scrubber system prevent the escape of any uranium along with the hydrogen. Rupture discs on the anhydrous HF system create the possibility of an accidental HF release.

DWG. NO. G-71-740



HIGH ASSAY FLUID BED, K-1131

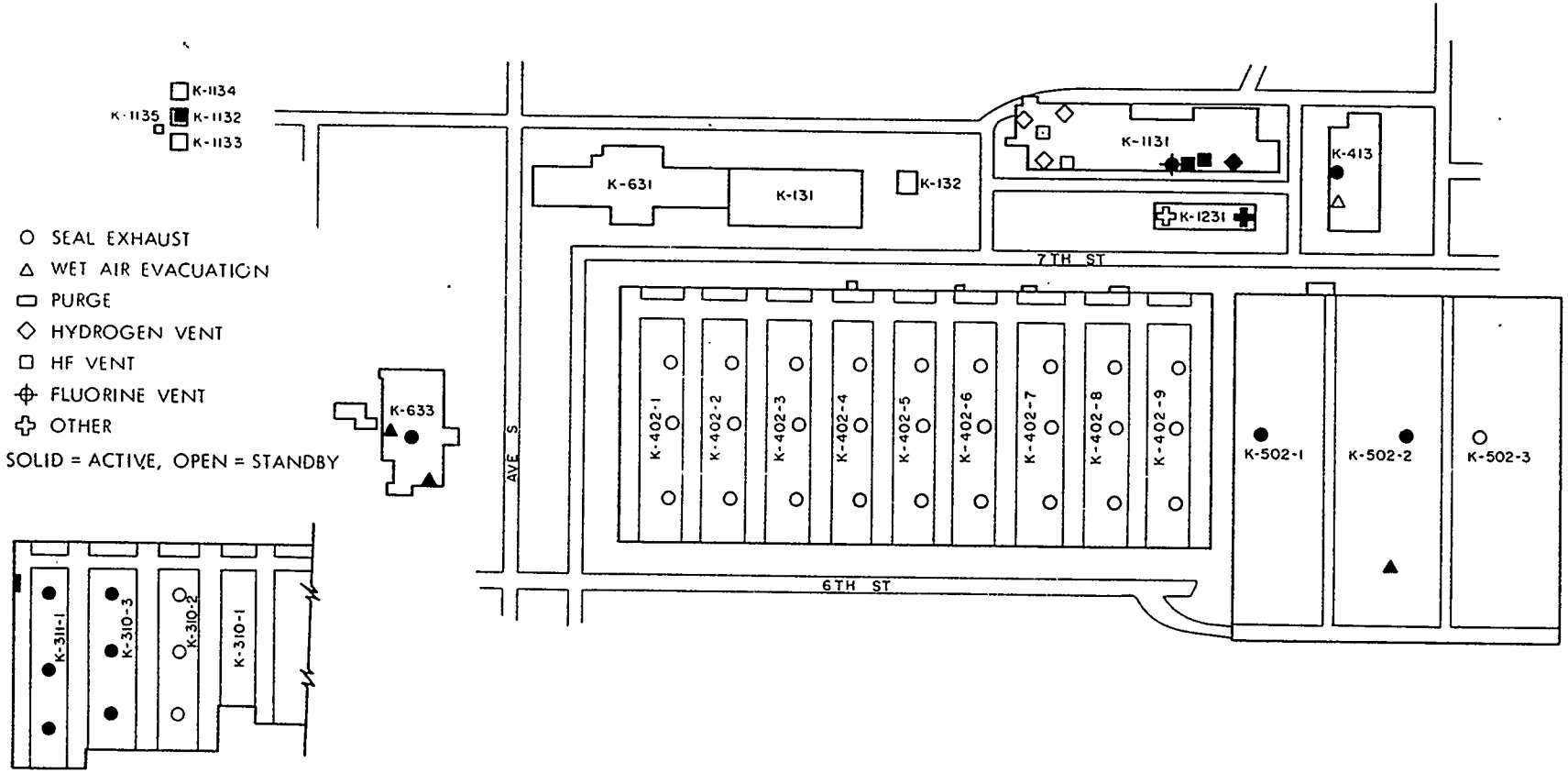
III. CLASSIFIED SECTION (K-PC-617)

The classified section of this report provides additional information on the operations involved as well as the complete description of the K-1231 Facility. A limited distribution has been made of this section.

IV. SUMMARY

The preceding sections have listed the K-29 Area gaseous effluent release points, described the operations that contribute the effluents, and provided information concerning the control and monitoring of systems now in use. The following area map has been included to give an overall view of these points. The type of exhaust, seal, purge, etc., and active or standby condition are indicated by symbols as shown on the following map. . . .

DWG. NO. G-71-691



K-29 GASEOUS EFFLUENT RELEASE POINTS

ACKNOWLEDGEMENT

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